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(54) Hydraulic accumulator

(57) An accumulator arrangement comprises a pressure transfer device having a body 1 and inlet and outlet ports 2 and 3 at opposite ends thereof which are formed for connection in a pipeline of a food processing plant. A resilient rubber sleeve 5 is disposed within the body 1 and liquid is disposed in the space defined between body 1 and sleeve 5. A port 7 leads from the body 1 to a conventional accumulator 9. Rises and falls in the pipeline pressure cause the sleeve 5 to extend or collapse which in turn results in liquid being pushed into or received from accumulator 9 until equilibrium is again reached. The smooth internal appearance of sleeve 5 minimizes the tendency of food particles to lodge therein. Other types of transfer barrier may be used depending on the application.

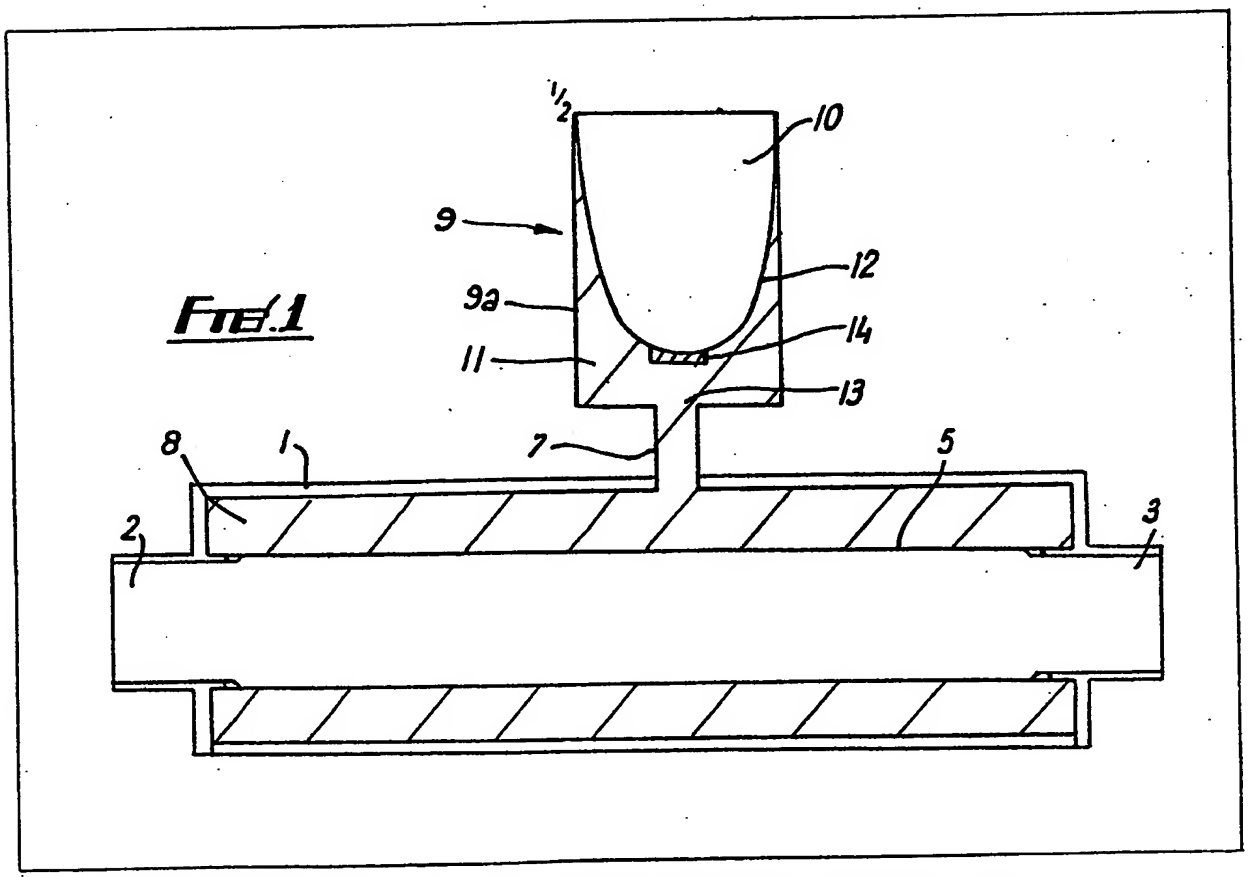

FIG.1

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The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

FIG. 1

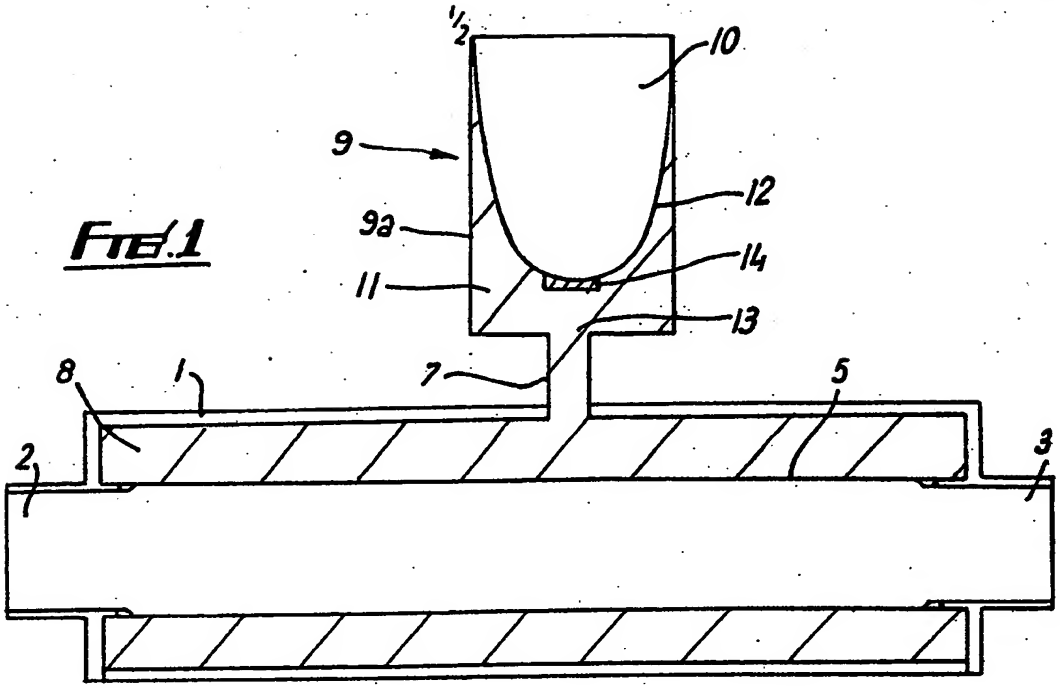


FIG. 2

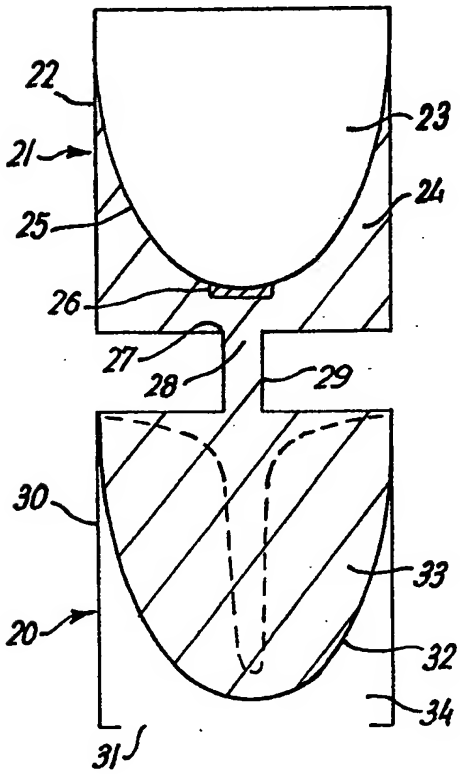
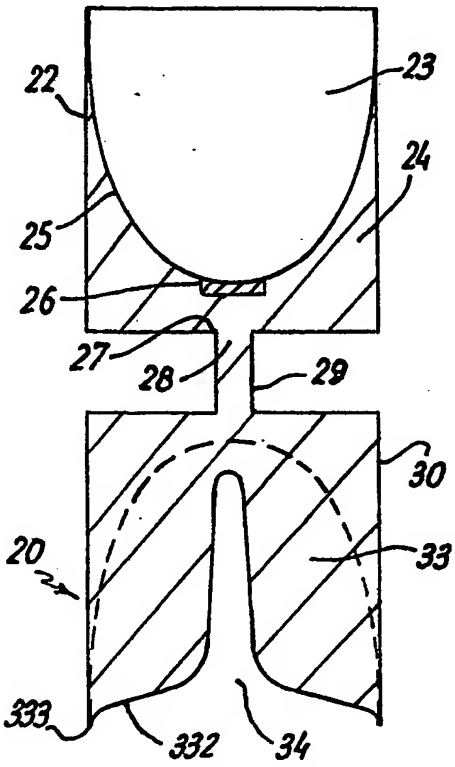


FIG. 3



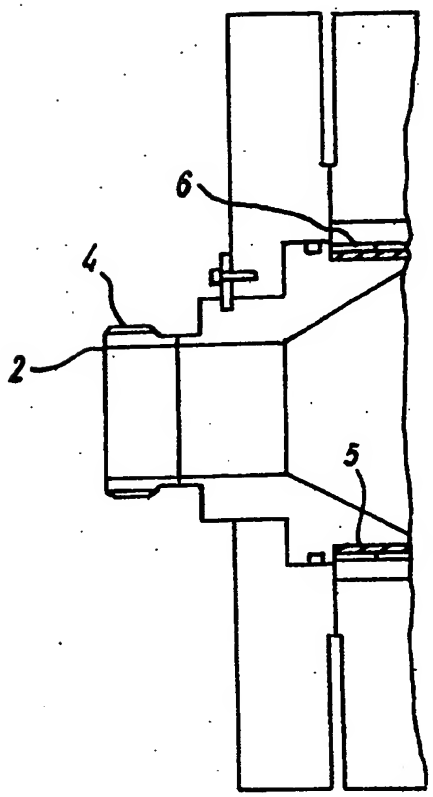


FIG. 1A

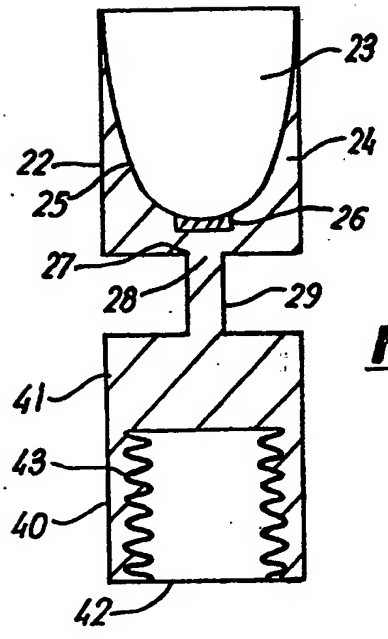


FIG. 4

SPECIFICATION

A transfer accumulator

The present invention relates to a transfer accumulator.

Hydropneumatic accumulators are employed, for example, in the food processing and chemical industries to absorb pressure surges and store excess energy generated in the fluid being processed. In food processing, one form of accumulator is connected to a special pipe-line section accommodating a supported sleeve which enables pressure pulsations to be transmitted via a gas barrier to the accumulator. The support which is necessary to prevent the gas forcing the sleeve out of the section defines many crevices which harbour food particles and which are difficult to clean. In plant handling corrosive chemicals, a bellow type stainless steel accumulator which is quite insensitive to pressure variations may be used. Other alternatives are air bottles and long lengths of hose and a bulk modulus type which is very large and relies on the compressibility of the system fluid. Air bottles tend to lose gas into process fluid because there is no separator and have to be topped up frequently. They are quite wasteful in volume. Long hoses can only be used for low pressure applications because damping depends on the resilience of the hose material. In high temperature applications a conventional bladder type accumulator may be mounted on a long standpipe to keep it away from the hot fluid. This reduces the damping effect and is not very effective anyway. Air bottle type suffers from disadvantages already mentioned (loss of gas etc.). Bellows dampers can only be used effectively at very low pressures. To withstand high precharge gas pressures the membrane material has to be relatively thick. This reduces the flexibility and cyclic life of the membrane.

According to the present invention, there is provided a transfer accumulator comprising a hydropneumatic accumulator connected to a transfer barrier in which the hydropneumatic accumulator has a body housing a partition which divides the interior of the body into two spaces one of which, in operation, accommodates a gas and the other of which, in operation, accommodates a liquid and the other of which, in operation, accommodates liquid and the transfer barrier also comprises a partition which divides the interior of the body into two spaces one of which is, in operation, in communication with the liquid accommodating space in the hydropneumatic accumulator and also, in operation accommodates the liquid and the other of which is adapted, in operation to receive process fluid from the system to which the transfer accumulator is in use to be connected.

A preferred embodiment of the invention may comprise any one or more of the following advantageous features:—

(a) The partition in the hydropneumatic accumulator is a bladder or diaphragm,

(b) The bladder or diaphragm of (a) is made of rubber,

(c) The bladder or diaphragm of (a) is made of synthetic plastics material,

(d) In operation, the gas in the gas accommodating space is nitrogen,

(e) The body of the transfer barrier is adapted to fit into a pipeline of the plant on which the transfer accummulator is to be used,

(f) The barrier comprises a sleeve disposed within the body of (e),

(g) The sleeve of (f) is made of rubber or other suitable resilient material such as synthetic plastics,

(h) The body of the transfer barrier defines a large output port to receive process fluid,

(i) The barrier of the body of (h) is a bladder or diaphragm and is made of rubber or other suitable resilient manterial such as synthetic plastics.

(j) The barrier of the body of (h) is a bellows,

(k) The bellows is made of a chemical and/or heat resistant material such as stainless steel,

(l) A valve is disposed between the hydropneumatic accumulator and the transfer barrier to limit the amount of liquid which can be pushed in operation by the gas from the hydropneumatic accumulator to the transfer barrier,

(m) The valve of (l) comprises a valve closure member connected to the underside of the barrier in the hydropneumatic accumulator and a valve seat disposed around the outlet from the hydropneumatic accumulator to the transfer barrier.

In order that the invention may be more clearly understood, several embodiments thereof will now be described, by way of example, with reference to the accompanying drawings, in which:—

Figure 1 shows diagrammatically a transfer accumulator for in line use for example, in food processing plant,

Figure 1a shows a detail view in section of part of the accumulator of Figure 1,

Figure 2 shows diagrammatically an alternative form of accumulator to that shown in Figure 1,

Figure 3 shows diagrammatically a modified form of the accumulator shown in Figure 2, and

Figure 4 shows diagrammatically another modified form of the accumulator shown in Figure 2.

Referring to Figures 1 and 1a, the transfer accumulator comprises a transfer barrier in the form of a cylindrical body 1 having inlet and outlet ports 2 and 3 at opposite ends thereof. Each port is specially formed for connection into a pipeline of a food processing plant as shown in more detail at 4 in Figure 1a. A substantially cylindrical resilient sleeve 5 is disposed substantially cylindrical resilient sleeve 5 is disposed substantially concentrically within, and spaced away from the inside of, the body 1, and is clamped at opposite ends respectively to the inner ends of the inlet and outlet ports by respective clamps 6 (see Figure 1a). The sleeve 5 is of rubber, but may be of any other suitable resilient material

such as synthetic plastics material.

A port 7 is formed in body 1 approximately midway between its two ends and connects the annular cross-section space 8 between the body 1 and the sleeve 5 with an accumulator 9 of conventional construction. This conventional accumulator 9 comprises a cylindrical body 9a defining two volumes 10 and 11 separated by a resilient rubber bladder or diaphragm 12. The point 13 at which the port 7 meets the accumulator 9 is formed into a valve seat and a valve closure member 14 is connected to the lower side of the bladder 12. An incompressible liquid occupies the spaces 8 and 11 and a gas under pressure such as nitrogen (N_2) occupies the space 10.

In operation, the above described transfer accumulator is connected into a pipeline of food processing plant in which pulsations are to be damped or energy stored. The inside of the sleeve 5 presents a continuous smooth surface to the fluid food material of the food process passing through it. If the pressure in the material rises the sleeve 5 expands under the additional pressure pushing incompressible liquid out of the space 8 into the space 11 and in turn compressing the nitrogen in the space 10 until equilibrium is reached. Should pressure in the material fall, the reverse occurs, gas pressure in the space 10 pushing liquid out of the space 11 into the space 8 until equilibrium is again reached. Excessive collapse of the sleeve 5 when the gas pressure exceeds the fluid food material pressure in the system is prevented by the valve comprising the valve closure member 14 and the valve seat 13 closing to prevent discharge of the incompressible liquid beyond a certain point. The smooth internal appearance of the sleeve 5 minimises the tendency of food particles to lodge therein and this in turn reduces the cleaning requirements. The device can be used at very high pressures.

A non-sleeve type of transfer accumulator is shown in Figure 2. This transfer accumulator comprises a transfer barrier 20 and a conventional accumulator 21. The conventional accumulator is of the same construction as that of the device of Figure 1, that is to say a cylindrical body 22 contains two volumes 23 and 24 separated by a resilient bladder 25. A valve closure member 26 is fixed to the underside of the bladder 25 and operatively cooperates with a valve seat 27 surrounding an inlet 28 to the body 22. The space 23 contains precharged pressurised nitrogen and the space 24 incompressible liquid.

This accumulator 21 is connected to the transfer barrier 20 *via* a port 29 which defines the inlet 28 at one end. This transfer barrier comprises a substantially cylindrical body 30 aligned with the accumulator 21. The cylindrical body 30 defines a large size inlet port 31 at its lower end remote from the port 29 and contains a resilient bladder 32 which divides the internal volume of the body 30 into two separate spaces 33 and 34. Space 33 communicates with space 24 and contains incompressible liquid and space 34 communicates with the process fluid itself.

This type of device is suitable for use in systems where the process fluid is heavily contaminated to form, for example, a slurry. When employing a conventional accumulator as a pulsation damper or for energy storage for such fluid, the relatively small inlet port may rapidly become clogged. Port sizes may be increased and provided with sieves, but clogging may still be a problem and/or the sieves may only be used at relatively low pressures. The use of the transfer barrier with the conventional accumulator enables a relatively large input port to be used.

The accumulator diagrammatically illustrated in Figure 3 is the same as that of Figure 2 except that the bladder 332 has its edge 333 fixed to the wall of the cylindrical body adjacent the inlet port 31 instead of adjacent the port 38.

Figure 4 illustrates an embodiment of a transfer accumulator similar to those of Figures 2 and 3 but suitable for use in the chemical and other process industries where a corrosive or high temperature liquid is used. The transfer accumulator comprises a conventional accumulator as in the embodiments of Figures 2 and 3 but instead of a bladder type transfer barrier, a bellows type barrier 40 is used. This barrier 40 comprises a substantially cylindrical body 41 having a relatively large output port 42 and housing a metal (preferably stainless steel or other chemical or heat resistant material) bellows 43. The use of such a barrier enables a much thinner membrane or bladder to be employed than would otherwise be the case. In effect the advantages of a bellow (i.e. resistance to chemicals and high temperature) are provided where they are needed and are combined with the sensitivity of a membrane or bladder also where needed.

It will be appreciated that the above embodiments have been described by way of example only and that many variations are possible without departing from the scope of the invention. In particular the application of this transfer barrier/accumulator arrangement is not restricted to the forms mentioned. Any type of accumulator may be combined with any type of transfer barrier depending on the particular application.

CLAIMS

1. A transfer accumulator comprising a hydropneumatic accumulator connected to a transfer barrier in which the hydropneumatic accumulator has a body housing a partition which divides the interior of the body into two spaces one of which, in operation, accommodates a gas and the other of which, in operation, accommodates a liquid and the transfer barrier also comprises a partition which divides the interior of the body into two spaces one of which is, in operation, in communication with the liquid accommodating space in the hydropneumatic accumulator and also, in operation accommodates the liquid and the other of which is adapted in operation, to

receive process fluid from the system to which the transfer accumulator is in use to be connected.

2. A transfer accumulator as claimed in Claim 1, in which the partition in the hydropneumatic accumulator is a bladder or diaphragm.

3. A transfer accumulator as claimed in Claim 2, in which the bladder or diaphragm is made of rubber.

4. A transfer accumulator as claimed in Claim 2, in which the bladder or diaphragm is made of synthetic plastics material.

5. A transfer accumulator as claimed in any preceding claim, in which in operation the gas in the gas accommodating space is nitrogen.

6. A transfer accumulator as claimed in any preceding claim, in which the body of the transfer barrier is adapted to fit into a pipeline of the plant on which the transfer accumulator is to be used.

7. A transfer accumulator as claimed in Claim 6, in which the barrier comprises a sleeve disposed with the body.

8. A transfer accumuator as claimed in Claim 7, in which the sleeve is made of rubber or other suitable resilient material such as synthetic plastics.

9. A transfer accumulator as claimed in any preceding claim, in which the body of the transfer barrier defines a large output port to receive process fluid.

10. A transfer accumulator as claimed in Claim 9, in which the barrier of the body is a bladder or diaphragm and is made of rubber or other suitable resilient material such as synthetic plastics.

11. A transfer accumulator as claimed in Claim 9, in which the barrier of the body is a bellows.

12. A transfer accumulator as claimed in Claim 11, in which the bellows is made of a chemical and/or heat resistant material such as stainless steel.

13. A transfer accumulator as claimed in any preceding claim, in which a valve is disposed between the hydropneumatic accumulator and the transfer barrier to limit the amount of liquid which can be pushed in operation by the gas from the hydropneumatic accumulator to the transfer barrier.

14. A transfer accumulator as claimed in Claim 13, in which the valve comprises a valve closure member connected to the underside of the barrier in the hydropneumatic accumulator and a valve seat disposed around the outlet from the hydropneumatic accumulator to the transfer barrier.

15. A transfer accumulator substantially as hereinbefore described with reference to Figures 1 and 1a, or Figure 2, or Figure 3 or Figure 4 of the accompanying drawings.

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